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SCREENING TESTS OF ORGANIC INSECTICIDES AGAINST CALIFORNIA RED SCALE, SECOND REPORT

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Screening tests with insecticides against the California red scale (Aonidiella aurantii (Mask)) made at Whittier, Calif., from 1949 through 1955 were summarized by Cressman et al.[1/] This report contains results of tests conducted from 1956 to 1958, and of preliminary field experiments with dimethoate, Diazinon, and Trithion.

The screening procedure was approximately the same as that described by Cressman et al. Except where indicated, 25-percent wettable powders of candidate materials prepared from technical samples were compared with parathion in laboratory sprays. New compounds were first tested at concentrations of 0.5 and 1 gram per liter. Those having toxicities comparable to that of parathion were then tested at lower concentrations. The treated scales were exposed to outdoor temperatures during the 8-week period between spray applications and mortality counts. The kill of scales by parathion was generally lower in this interval during the winter because of slower action at low temperatures. It is not known whether test materials were similarly affected.

Laboratory Tests

Compounds that gave at least 50-percent mortality of the mature female scales at a concentration of 1 gram per liter or had marked residual effect on young produced by the sprayed females are listed in table 1. Materials that appeared to be about equal to or better than parathion included Chipman R-6199, Monsanto CP-7768, General Chemical 4072, American Cyanamid 18706, and dimethoate. All but the last two of these materials are highly toxic to mammals. Dimethoate, among the least toxic of organophosphorus pesticides to mammals, was the most effective compound against the California red scale in laboratory tests and was more than four times as effective as parathion.

1/ Cressman, A. W., Bessie M. Broadbent, and Francis Munger. 1957. Screening tests of some organic insecticides against the California red scale. U. S. Dept. of Agric., ARS 33-40.

Wettable powders of ethion, Sevin, and Hercules 1986 had little effect on mature red scales but prolonged residual action against young scales in the following generation. Cressman[2/] has shown that such materials may be more effective when used in emulsifiable concentrates or dilute solutions in a carrier such as kerosene. Solutions of Hercules 1986 in kerosene were much more effective than the wettable powder but still inferior to parathion applied in the same way. A fine suspension of Sevin in an emulsifiable mixture was no more effective than the wettable powder. Riehl et al.[3/] have reported that the performance of ethion in oil is comparable to that of malathion in oil against adult red scales but that malathion is superior to ethion when both are used in kerosene.

In other tests, stems of scale-infested lemons were immersed in solutions of dimethoate prepared from a solubilized formulation with different concentrations, periods of immersion, and ages of scales. High mortality resulted from all tests, even among adult scales on lemons immersed in a 1 to 1,000 solution for 24 hours. The tests were conducted in an outdoor lath house to minimize the effect of fumigation but apparently this effect was not eliminated entirely. When two infested lemons were placed near an open bottle containing a 1 to 100 mixture of dimethoate and water for 24 hours and then removed, mortalities 8 weeks later were 78 and 88 percent on the halves of the lemons next to the mixture. On the opposite halves, only 8 and 4 percent of the scales were killed.

Field Experiments

Diazinon showed sufficient toxicity in earlier laboratory screening tests by Cressman et al.[4/] to merit field trials. In September 1955, applications of sprays of emulsifiable concentrates of Diazinon and parathion were made to heavily infested lemon trees. Pretreatment infestation was one adult scale per 6-inch twig unit with no differences between plots. The weather during the period between application of sprays and final counts was very favorable for scale increase. The amounts of insecticides used and average infestations 13 months after spraying were as follows:

Insecticide and pounds per 100 gallons		Scales per fruit
Parathion	0.375	0.7
Diazinon	.375	3.8
Diazinon	.75	2.0

2/ Cressman, A. W. 1958. Effectiveness of different formulations of insecticides against California red scale. J. Econ. Ent. 51: 911-912.

3/ Riehl, L. A., J. P. LaDue, and J. L. Rodriquez, Jr. 1959. Efficiency of ethion in oil spray against California red scale and citrus red mite. J. Econ. Ent. 52: 857-860.

4/ See footnote 1/.

When Cressman[5/] tested Trithion formulations in the laboratory, he found a kerosene solution most effective, an emulsifiable concentrate less so, and a wettable powder suspension least effective. The first two formulations were effective against scales in limited field trials but all three caused slight injury. Interest in Trithion as a combined scalicide and miticide has declined because of the finding by Jeppson et al.[6/] that citrus red mites (Panonychus citri McG.), which have developed resistance to parathion and demeton, are also highly resistant to Trithion.

Dimethoate appeared to be the most promising of materials listed in table 1. Field sprays of an emulsifiable concentrate at the rate of 0.5 and 1 pound of technical dimethoate per 100 gallons applied to lemon trees on October 28, 1958, showed little kill of mature scales on the branches in January 1959; but very few of the young scales were able to develop. Additional sprays of dimethoate wettable powder and parathion emulsion applied to navel orange trees on September 15, 1959, gave mortalities about 9 weeks later as shown in table 2. The effectiveness of parathion against scales on wood, and that of dimethoate against scales on fruit suggested the possible usefulness of combinations of the two materials.

Dimethoate may be more effective against infestation on the wood than indicated by initial mortality counts. On June 2, 1958, when heavily infested lemon trees with most of the scales on the branches were sprayed with the same concentrations of dimethoate as those shown in table 2, infestations were low in all plots the following December. Apparently the effect of dimethoate on young scales at the time of application and the residual action of the insecticide on young produced by mature survivors were sufficient to maintain good control during this period. There was no plant injury from any of these sprays.

Materials Used

Chemical names of proprietary products and other materials which had little or no effect on the California red scale at a concentration of 1 gram per liter were as follows:

Bayer 22408 (O, O-diethyl O-naphthalimidophosphorothioate)
Bayer 22684 (2-chloroethyl 2, 2-dichlorovinyl methyl phosphate)
Bayer 23129 (S-2(ethylthio)ethyl O, O-dimethyl phosphorodithioate)
Bayer 23453 (S-2-(ethylsulfinyl)ethyl O, O-dimethyl phosphorodithioate)
Bayer 24498 (O, O-dimethyl S-2-(methylsulfinyl)ethyl phosphorothioate)
Bayer 25198 (O, O-dimethyl O-p-methylsulfinylphenyl phosphorothioate)
Bayer 37342 (O, O-dimethyl O-(3, 5-dimethyl-4-methylthiophenyl) phosphorothioate)

5/ See footnote 2/.

6/ Jeppson, L. R., M. J. Jesser, and J. O. Complin. 1958. Resistance of the citrus red mite to organic phosphates in California. J. Econ. Ent. 51: 232-233.

Dibrom (1, 2-dibromo-2, 2-dichloroethyl dimethyl phosphate)
Gen. Chem. 3561 (dimethyl 2-(1, 1, 3-tetrafluro-2-hydroxy) propylphosphate)
Gen. Chem. 3562 (diethyl 2-(1, 1, 3-tetrafluoro-2-hydroxy) propylphosphate)
Monsanto CP-10502 (1-(dimethoxyphosphinyl)vinyl dimethyl phosphate)
Thiodan (6, 7, 8, 9, 10, 10-hexachloro-1, 5, 5a, 6, 9, 9a-hexahydro-6-9-methano-2, 4, 3-benzodioxathiepinoxide-3-oxide)

Chemical names of proprietary products and other materials which showed toxicity to the California red scale as indicated in the text and in the tables are as follows:

Amer. Cyan. 18706 (O, O-dimethyl S-(N-ethylcarbamoylmethyl) phosphorodithioate)
Bayer 24869 (1-chloro-2-propyl 2, 2-dichlorovinyl ethyl phosphate)
Bayer 25141 (O, O-diethyl O-p-methylsulfinylphenyl phosphorothioate)
Chipman R-6199 (O, O-diethyl S-(2-diethylamino)ethyl phosphorothioate /hydrogen oxalate salt/)
Diazinon (O, O-diethyl O-(2-isopropyl-4-methyl-6-pyrimidinyl) phosphorothioate)
Dimethoate
Di-Syston (O, O-diethyl S-2-(ethylthio)ethyl phosphorodithioate)
Ethion
Gen. Chem. 3582 (1-(2, 5-dichlorophenyl)-2, 2-dichlorovinyl diethyl)
Gen. Chem. 3583 (2-chloro-1-(2, 5-dichlorophenyl)vinyl diethyl phosphate)
Gen. Chem. 3661 (1, 3-bis(methoxycarbonyl)-1-propen-2-yl diethyl phosphate)
Gen. Chem. 3707 (1, 3-bis(methoxycarbonyl)-1-propen-2-yl dimethyl phosphate)
Gen. Chem. 4072 (2-chloro-1-(2, 4-dichlorophenyl)vinyl diethyl phosphate)
Hercules 1986 (S-(O, O-diethyl phosphorodithioate) of trichlorotetrahydropyranthiol)
Hercules 3004 (diethyl 1-ethylthio-1-propen-2-yl phosphate)
Hercules 3895 (2, 2-bis(ethylthio)vinyl diethyl phosphate)
Hercules 5727 (m-isopropylphenyl methylcarbamate)
Monsanto CP-7768 (p-chlorophenyl trichloromethyl disulfide, triethyl phosphite reaction product)
Monsanto CP-7769 (hexaethyl (ethylthiomethylidyne)triphosphonate)
Monsanto CP-8574 (tetramethyl (dithiomethylene)diphosphonate)
Monsanto CP-8810 (S-(p-chlorophenyl)O, O-diethyl phosphorothioate)
Monsanto CP-10516 (1-(diethoxyphosphinyl)vinyl dimethyl phosphate)
Monsanto CP-12432 (diethyl 1-(dimethoxyphosphinyl)vinyl phosphate)
Phosphamidon
Sevin (1-naphthyl methylcarbamate)
Trithion (S-(p-chlorophenylthio)methyl O, O-diethyl phosphorodithioate)

Table 1.--Comparative toxicities and residual effectiveness of organic insecticides and parathion to mature female California red scale on lemons. (All formulations are 25-percent wettable powders except where indicated.)

Insecticide (grams per liter)	Percent mortality		Adult offspring per sprayed female	
	Test insecticide	Parathion	Test insecticide	Parathion
Amer. Cyan. 18706				
0.25	--	85	--	0.68
.50	87	92	0.39	.33
1.00	98	--	.01	--
Bayer 24869				
0.25	--	51	--	0
.50	60	72	0.19	0.01
1.00	76	--	.05	--
Bayer 25141				
0.25	--	51	--	0
.50	43	72	0.03	0.01
1.00	48	--	.00+	--
Chipman R-6199				
0.25	98	59	0.00+	0.17
.50	99	92	0	.10
Dimethoate				
0.125	98	52	0	1/
.25	100	71	0	1/
.50	100	71	0	1/
Di-Syston				
0.25	--	43	--	0.00+
.50	49	75	0	0
1.00	75	--	0	--
Ethion				
0.25	--	63	--	0.00+
.50	16	81	0	0
1.00	17	--	0	--
Gen. Chem. 3582				
0.25	--	69	--	0.32
.50	80	94	0	.02
1.00	87	--	0	--
Gen. Chem. 3583				
0.25	--	69	0	--
.50	50	94	0	0.32
1.00	73	--	--	.02

Table 1.--Continued

Insecticide (grams per liter)	Percent mortality		Adult offspring per sprayed female	
	Test insecticide	Parathion	Test insecticide	Parathion
Gen. Chem. 3661				
0.25	--	63	--	--
.50	82	95	0.18	1.3
1.00	94	--	.04	.03
Gen. Chem. 3707				
0.25	--	63	--	1.3
.50	59	95	1.7	0.03
1.00	79	--	0.11	--
Gen. Chem. 4072				
0.125	15	--	0.00+	--
.25	42	51	0	0
.50	63	72	0	.01
Hercules 1986				
0.25	--	59	--	0.17
.50	22	92	0.00+	.10
1.00	42	--	0	--
Hercules 3004				
0.25	--	81	--	0
.5	66	96	1.5	0
1.00	86	--	0.3	--
Hercules 3895 (emulsion concentrate)				
0.25	--	81	--	0
.50	60	96	0.10	0
1.00	51	--	.45	--
Hercules 5727				
0.25	--	85	--	--
.50	56	92	2/	0.68
1.00	61	--	2/	.33
Monsanto CP-7768				
0.125	15	--	0	--
.25	62	43	0	0.00+
.50	82	75	0	0
Monsanto CP-7769				
0.125	28	--	2/	--
.25	54	51	2/	0
.50	88	72	0.07	0.01

Table 1.--Continued

Insecticide (grams per liter)	Percent mortality		Adult offspring per sprayed female	
	Test insecticide	Parathion	Test insecticide	Parathion
Monsanto CP-8574				
0.25	--	63	--	0.00+
.50	46	81	0.18	0
1.00	53	--	.44	--
Monsanto CP-10516				
0.25	--	63	--	1.3
.50	35	95	2/	0.03
1.00	50	--	3.2	--
Monsanto CP-12432				
0.25	--	69	--	0.32
.50	23	94	2/	.02
1.00	53	--	2/	--
Phosphamidon				
0.25	--	85	--	0.68
.50	53	92	2/	.33
1.00	67	--	0.99	--
Sevin				
0.25	--	43	--	0.00+
.50	15	75	0.01	0
1.00	20	--	0	--

1/ New adults not counted.
2/ No significant residual action.

Table 2.--Mortality of adult California red scales on navel orange trees 9 weeks after spraying with parathion and dimethoate.

Insecticide and dosage (lb./100 gal.)	Percent mortality on--	
	Fruit	Wood
Parathion, 0.4	42	96
Dimethoate, 0.5	92	58
.75	97	74
Parathion, 0.25 + dimethoate, 0.25	90	83
Parathion, 0.25 + dimethoate, 0.125	63	87